S207 The Physical World
Bookmark

The Open University

Useful constants

magnitude of the acceleration due to gravity (on Earth)	$g = 9.81\ \text{m s}^{-2}$
Newton's universal gravitational constant	$G = 6.673 \times 10^{-11}\ \text{N m}^2\ \text{kg}^{-2}$
Avogadro's constant	$N_\text{m} = 6.022 \times 10^{23}\ \text{mol}^{-1}$
Boltzmann's constant	$k = 1.381 \times 10^{-23}\ \text{J K}^{-1}$
molar gas constant	$R = 8.314\ \text{J K}^{-1}\ \text{mol}^{-1}$
permittivity of free space	$\varepsilon_0 = 8.854 \times 10^{-12}\ \text{C}^2\ \text{N}^{-1}\ \text{m}^{-2}$
	$1/4\pi\varepsilon_0 = 8.988 \times 10^{9}\ \text{N m}^2\ \text{C}^{-2}$
permeability of free space	$\mu_0 = 4\pi \times 10^{-7}\ \text{T m A}^{-1}$
speed of light in vacuum	$c = 2.998 \times 10^{8}\ \text{m s}^{-1}$
Planck's constant	$h = 6.626 \times 10^{-34}\ \text{J s}$
	$\hbar = h/2\pi = 1.055 \times 10^{-34}\ \text{J s}$
Rydberg constant	$R = 1.097 \times 10^{7}\ \text{m}^{-1}$
Bohr radius	$a_0 = 5.292 \times 10^{-11}\ \text{m}$
atomic mass unit	amu (or u) $= 1.6605 \times 10^{-27}\ \text{kg}$
charge of proton	$e = 1.602 \times 10^{-19}\ \text{C}$
charge of electron	$-e = -1.602 \times 10^{-19}\ \text{C}$
electron rest mass	$m_\text{e} = 9.109 \times 10^{-31}\ \text{kg}$
charge to mass ratio of the electron	$-e/m_\text{e} = -1.759 \times 10^{11}\ \text{C kg}^{-1}$
proton rest mass	$m_\text{p} = 1.673 \times 10^{-27}\ \text{kg}$
neutron rest mass	$m_\text{n} = 1.675 \times 10^{-27}\ \text{kg}$
radius of the Earth	$6.378 \times 10^{6}\ \text{m}$
mass of the Earth	$5.977 \times 10^{24}\ \text{kg}$
mass of the Moon	$7.35 \times 10^{22}\ \text{kg}$
mass of the Sun	$1.99 \times 10^{30}\ \text{kg}$
average radius of Earth orbit	$1.50 \times 10^{11}\ \text{m}$
average radius of Moon orbit	$3.84 \times 10^{8}\ \text{m}$

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SI unit conversions [The fundamental units are: m; kg; s; A; K, mol.]

Quantity	Unit	Conversion
speed	$\mathrm{m\,s^{-1}}$	
acceleration	$\mathrm{m\,s^{-2}}$	
angular speed	$\mathrm{rad\,s^{-1}}$	
angular acceleration	$\mathrm{rad\,s^{-2}}$	
linear momentum	$\mathrm{kg\,m\,s^{-1}}$	
angular momentum	$\mathrm{kg\,m^2\,s^{-1}}$	
force	newton (N)	$1\ \mathrm{N} = 1\ \mathrm{kg\,m\,s^{-2}}$
energy	joule (J)	$1\ \mathrm{J} = 1\ \mathrm{N\,m}$
		$= 1\ \mathrm{kg\,m^2\,s^{-2}}$
torque	N m	
power	watt (W)	$1\ \mathrm{W} = 1\ \mathrm{J\,s^{-1}}$
pressure	pascal (Pa)	$1\ \mathrm{Pa} = 1\ \mathrm{N\,m^{-2}}$
frequency	hertz (Hz)	$1\ \mathrm{Hz} = 1\ \mathrm{s^{-1}}$
charge	coulomb (C)	$1\ \mathrm{C} = 1\ \mathrm{A\,s}$
potential difference	volt (V)	$1\ \mathrm{V} = 1\ \mathrm{J\,C^{-1}}$
electric field	$\mathrm{N\,C^{-1}}$	$1\ \mathrm{N\,C^{-1}} = 1\ \mathrm{V\,m^{-1}}$
resistance	ohm (Ω)	$1\ \Omega = 1\ \mathrm{V\,A^{-1}}$
capacitance	farad (F)	$1\ \mathrm{F} = 1\ \mathrm{A\,s\,V^{-1}}$
inductance	henry (H)	$1\ \mathrm{H} = 1\ \mathrm{V\,s\,A^{-1}}$
magnetic field	tesla (T)	$1\ \mathrm{T} = 1\ \mathrm{N\,s\,m^{-1}\,C^{-1}}$
		$= 1\ \mathrm{kg\,s^{-2}\,A^{-1}}$

Useful conversions

1 degree ≈ 0.01745

1 radian ≈ 57.30 degrees

absolute zero: 0 K = –273.15 °C

1 electronvolt (eV) = 1.602×10^{-19} J

Derivatives

[A, n, k and ω are constants; x, y, and z are functions of t]

x	$\frac{\mathrm{d}x}{\mathrm{d}t}$
A	0
t^n	nt^{n-1}
$\sin \omega t$	$\omega \cos \omega t$
$\cos \omega t$	$-\omega \sin \omega t$
e^{kt}	$k\mathrm{e}^{kt}$
Ay	$A\frac{\mathrm{d}y}{\mathrm{d}t}$
$y + z$	$\frac{\mathrm{d}y}{\mathrm{d}t} + \frac{\mathrm{d}z}{\mathrm{d}t}$